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10/562,327	12/23/2005	Toru Takenaka	SAT-16312	3766

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RANKIN, HILL & CLARK LLP
38210 Glenn Avenue
WILLOUGHBY, OH 44094-7808

EXAMINER	
SAMPLE, JONATHAN L	

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4184	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/562,327	Applicant(s) TAKENAKA ET AL.
	Examiner JONATHAN SAMPLE	Art Unit 4184

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-16* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-16* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *23 December 2005* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *011706; 011706; 011706; 033108*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Receipt is acknowledged of the Information Disclosure Statements (IDS), three on 1/17/2006, and 3/31/2008. Claims 1-16 are pending.

Specification

1. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 1, 2, 5, 6, 8 and 9 are rejected under 35 U.S.C. 102(b) as being anticipated by Hattori et al (US 2003/0009259 A1).

Re claim 1. A control device for generating a desired gait of a legged mobile robot that travels by moving a plurality of legs extended from its body and for controlling an operation of the robot so as to follow the desired gait, comprising:

slippage determining means (Figure 10, relative movement measurement sensors 362 and Figure 11, relative movement measurement sensor 1104) for determining an occurrence of a slippage of the robot in operation, following the desired gait (see paragraphs 110 and 115);

permissible range setting means (Figure 10, CPU 311) for variably setting a permissible range of a restriction object amount according to a determination result of the slippage determining means, the restriction object amount being a horizontal component of a translational floor reaction force to be applied to the robot, or a component of the translational floor reaction force in parallel to a floor surface, or a horizontal component of a total center-of-gravity acceleration of the robot, or a component of the total center-of-gravity acceleration in parallel to a floor surface (Figures 12,13, 20A and 20B also see paragraphs 113, 137, 138 and 157-159). It is interpreted that since there are threshold values in regards to slipping of the robot, then a range is created, between no slipping and the preset threshold value;

provisional motion determining means (Figure 10, movement control module 300) for determining a provisional motion of the desired gait such that a resultant force of a gravity and an inertial force acting on the robot on a predetermined dynamic model satisfies a predetermined dynamic balance condition (Figures 21 and 22, also see paragraphs 108, 113, 154, 165 and 166); and

provisional motion correcting means (Figure 10, movement control module 300) for correcting the provisional motion to determine the motion of a desired gait by changing a changing rate of an angular momentum about the center-of-gravity of a robot from the provisional motion so as to limit the restriction object amount to the permissible range while satisfying the dynamic balance condition at the same time if the restriction object amount determined by the provisional motion

of the desired gait deviates from the permissible range (Figure 23, and paragraphs 108, 154, and 174-178).

Re claim 2. A control device for generating a desired gait of a legged mobile robot that travels by moving a plurality of legs extended from its body and for controlling an operation of the robot so as to follow the desired gait, comprising:

slippage determining means (Figure 10, relative movement measurement sensors 362 and Figure 11, relative movement measurement sensor 1104) for determining an occurrence of a slippage of the robot in operation, following the desired gait (see paragraphs 110 and 115);

permissible range setting means (Figure 10, CPU 311) for variably setting a permissible range of a restriction object amount according to a determination result of the slippage determining means, the restriction object amount being a vertical component of a floor reaction force moment to be applied to the robot or a component of the floor reaction force moment in the direction of a floor surface normal line or a vertical component of a changing rate of angular momentum of the robot, or a component of the changing rate of the angular momentum in the direction of floor surface normal line (Figures 12,13, 20A and 20B also see paragraphs 113, 137, 138 and 157-159). t is interpreted that since there are threshold values in regards to slipping of the robot, then a range is created, between no slipping and the preset threshold value;

provisional motion determining means (Figure 10, movement control module 300) for determining a provisional motion of the desired gait such that a resultant force of a gravity and an inertial force acting on the robot on a predetermined dynamic model satisfies a predetermined

dynamic balance condition (Figures 21 and 22, also see paragraphs 108, 113, 154, 165 and 166); and

provisional motion correcting means (Figure 10, movement control module 300) for correcting the provisional motion to determine the motion of a desired gait by changing a changing rate of an angular momentum of the robot from the provisional motion so as to restrict the restriction object amount within the permissible range while satisfying the dynamic balance condition at the same time if the restriction object amount determined by the provisional motion of the desired gait deviates from the permissible range (Figure 23, and paragraphs 108, 154, and 174-178).

Re claim 5 and 8. Hattori et al teaches wherein the slippage determining means determines an occurrence of a slippage on the basis of at least the ground speed of a distal portion of a leg in contact with the ground (Figure 23 and see paragraphs 47, 56 and 178-181). Hattori et al teaches that based on the slip between the foot of the robot and the ground, that the speed (speed between the ground and the foot of the robot) is adjusted to keep the robot safe and prevent the robot from falling.

Re claim 6 and 9. Hattori et al teaches wherein the slippage determining means (Figure 12, relative movement measurement sensor 1104) comprises means for determining, on the basis of at least a temporal changing rate of an actual floor reaction force acting on a leg in contact with the ground and the ground speed of a distal portion of the leg, an apparent spring constant of the leg and determines an occurrence of a slippage on the basis of at least the apparent spring constant (see paragraphs 123, 124 and126-129). Hattori et al discloses that a ball (Figure 12, ball

1301) on the foot of the robot is adjacent to an X-axis roll (Figure 12, roll 1303) and a Y-axis roll (Figure 12, roll 1304). Hattori et al also teaches another roll (Figure 12, roll 1305) is used to press the ball against rolls 1303 and 1304 under the force of a spring (Figure 12, spring 1306). It is inherent that based on the spring constant of the spring and the rotation of the ball on a surface, that the slip therefore can be determined.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claims 3, 4, 7 and 10-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hattori et al in view of Takenaka et al (US 6,289,265 B1).

Re claim 3. Hattori et al teaches a control device of a legged mobile robot adapted to sequentially determine an instantaneous value of a desired motion of a legged mobile robot, which travels by moving legs extended from its body, by using a dynamic model that at least expresses a relationship between a motion of the robot and a floor reaction force, and also to control an operation of the robot at the same time so as to make the robot follow the determined instantaneous value of the desired motion, comprising: slippage determining means (Figure 10, relative movement measurement sensors 362 and Figure 11, relative movement measurement sensor 1104) for determining an occurrence of a slippage of the robot in operation, following the

desired motion (see paragraphs 110 and 115); permissible range setting means (Figure 10, CPU 311) for variably setting a permissible range of a restriction object amount according to a determination result of the slippage determining means, the restriction object amount being at least a horizontal component of a translational floor reaction force to be applied to the robot, or a component of the translational floor reaction force in parallel to a floor surface, or a horizontal component of a total center-of-gravity acceleration of the robot, or a component of the total center-of-gravity acceleration in parallel to a floor surface (Figures 20A, 20B, 21 and 22, also see paragraphs 113, 138, 157-159, and 165-166). Hattori et al specifically fails to disclose desired instantaneous value determining means for determining, on the basis of at least the difference between a desired state amount of a posture of the robot that corresponds to the determined instantaneous value of the desired motion and an actual state amount of the posture of the robot, a new instantaneous value of the desired motion such that the restriction object amount determined on the basis of the dynamic model in correspondence to the new instantaneous value falls within the permissible range and the difference approximates zero.

Takenaka et al teaches desired instantaneous value determining means for determining, on the basis of at least the difference between a desired state amount of a posture of the robot that corresponds to the determined instantaneous value of the desired motion and an actual state amount of the posture of the robot, a new instantaneous value of the desired motion such that the restriction object amount determined on the basis of the dynamic model in correspondence to the new instantaneous value falls within the permissible range and the difference approximates zero (Figure 10 and column 18, lines 38-43 and 57-64).

In view of Takenaka et al's teachings, it would have been obvious to one of ordinary skill in the art at the time of the invention to include, with the control device of a legged mobile robot as taught by Hattori et al, desired instantaneous value determining means for determining, on the basis of at least the difference between a desired state amount of a posture of the robot that corresponds to the determined instantaneous value of the desired motion and an actual state amount of the posture of the robot, a new instantaneous value of the desired motion such that the restriction object amount determined on the basis of the dynamic model in correspondence to the new instantaneous value falls within the permissible range and the difference approximates zero; since Takenaka et al teaches that instantaneous values for the desired gait of the robot give the robot ideal position/orientation, to aid in the prevention of slippage.

Re claim 4. Hattori et al teaches a control device of a legged mobile robot adapted to sequentially determine instantaneous values of a desired motion and a desired floor reaction force of a legged mobile robot, which travels by moving legs extended from its body, by using a dynamic model that expresses at least a relationship between a motion of the robot and a floor reaction force, and also to control an operation of the robot at the same time so as to make the robot follow the determined instantaneous values of the desired motion and the desired floor reaction force, comprising: slippage determining means (Figure 10, relative movement measurement sensors 362 and Figure 11, relative movement measurement sensor 1104) for determining an occurrence of a slippage of the robot in operation, following the desired motion and the desired floor reaction force (see paragraphs 110 and 115); permissible range setting means (Figure 10, CPU 311) for variably setting a permissible range of a restriction object

amount according to a determination result of the slippage determining means, the restriction object amount being at least a horizontal component of a translational floor reaction force to be applied to the robot, or a component of the translational floor reaction force in parallel to a floor surface, or a horizontal component of a total center-of-gravity acceleration of the robot, or a component of the total center-of-gravity acceleration in parallel to a floor surface (Figures 20A, 20B, 21 and 22, also see paragraphs 113, 138, 157-159, and 165-166); Hattori et al specifically fails to teach desired instantaneous value determining means for determining, on the basis of at least the difference between a desired state amount of a posture of the robot that corresponds to the determined instantaneous values of the desired motion and the desired floor reaction force and an actual state amount of the posture of the robot, new instantaneous values of the desired motion and the desired floor reaction force such that the restriction object amount determined on the basis of the dynamic model in correspondence to the new instantaneous value of the desired motion falls within the permissible range and the difference approximates zero.

Takenaka et al teaches desired instantaneous value determining means for determining, on the basis of at least the difference between a desired state amount of a posture of the robot that corresponds to the determined instantaneous values of the desired motion and the desired floor reaction force and an actual state amount of the posture of the robot, new instantaneous values of the desired motion and the desired floor reaction force such that the restriction object amount determined on the basis of the dynamic model in correspondence to the new instantaneous value of the desired motion falls within the permissible range and the difference approximates zero (Figure 10 and column 18, lines 38-43 and 57-64).

In view of Takenaka et al's teachings, it would have been obvious to one of ordinary skill in the art at the time of the invention to include, with the control device of a legged mobile robot as taught by Hattori et al, desired instantaneous value determining means for determining, on the basis of at least the difference between a desired state amount of a posture of the robot that corresponds to the determined instantaneous value of the desired motion and an actual state amount of the posture of the robot, a new instantaneous value of the desired motion such that the restriction object amount determined on the basis of the dynamic model in correspondence to the new instantaneous value falls within the permissible range and the difference approximates zero; since Takenaka et al teaches that instantaneous values for the desired gait of the robot give the robot ideal position/orientation, to aid in the prevention of slippage.

Re claim 7, 10, 13 and 16. Hattori et al specifically fails to disclose wherein the slippage determining means determines an occurrence of a slippage on the basis of at least a result obtained by passing an actual floor reaction force acting on a leg in contact with the ground through a band-pass filter having a frequency passing characteristic in a range near a predetermined frequency.

Takenaka et al teaches wherein the slippage determining means determines an occurrence of a slippage on the basis of at least a result obtained by passing an actual floor reaction force acting on a leg in contact with the ground through a low-pass filter having a frequency passing characteristic in a range near a predetermined frequency (column 27, lines 17-26 and column 32, lines 47-62). Takenaka et al discloses a low-pass filter, which is interpreted to transmit

frequencies below a certain value, producing a similar result of a band-pass filter that typically only transmits frequencies within a selected band.

In view of Takenaka et al's teachings, it would have been obvious to one of ordinary skill in the art at the time of the invention to include with the control device of a legged mobile robot as taught by Hattori et al, wherein the slippage determining means determines an occurrence of a slippage on the basis of at least a result obtained by passing an actual floor reaction force acting on a leg in contact with the ground through a band-pass filter having a frequency passing characteristic in a range near a predetermined frequency, since Takenaka et al teaches that the floor reaction force is filtered through a low-pass filter to improve the frequency response characteristic of the transfer function from the difference moment to the actual floor reaction force (column 27, lines 17-26).

Re claim 11 and 14. Hattori et al teaches wherein the slippage determining means determines an occurrence of a slippage on the basis of at least the ground speed of a distal portion of a leg in contact with the ground (Figure 23 and see paragraphs 47, 56 and 178-181). Hattori et al teaches that based on the slip between the foot of the robot and the ground, that the speed (speed between the ground and the foot of the robot) is adjusted to keep the robot safe and prevent the robot from falling.

Re claim 12 and 15. Hattori et al teaches wherein the slippage determining means (Figure 12, relative movement measurement sensor 1104) comprises means for determining, on the basis of at least a temporal changing rate of an actual floor reaction force acting on a leg in contact with

the ground and the ground speed of a distal portion of the leg, an apparent spring constant of the leg and determines an occurrence of a slippage on the basis of at least the apparent spring constant (see paragraphs 123, 124 and126-129). Hattori et al discloses that a ball (Figure 12, ball 1301) on the foot of the robot is adjacent to an X-axis roll (Figure 12, roll 1303) and a Y-axis roll (Figure 12, roll 1304). Hattori et al also teaches another roll (Figure 12, roll 1305) is used to press the ball against rolls 1303 and 1304 under the force of a spring (Figure 12, spring 1306). It is inherent that based on the spring constant of the spring and the rotation of the ball on a surface, that the slip therefore can be determined.

Conclusion

6. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Nagle (US 5,644,204) teaches an anti-slip control for a mobile robot. Nishikawa et al (US 6,021,363) teaches a system for detecting and controlling the position of a mobile robot.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jonathan Sample whose telephone number is (571)270-5925. The examiner can normally be reached on M-TH 7-4:30, Alternating Fridays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jared Fureman can be reached on 571-272-2391. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/JONATHAN SAMPLE/
Examiner, Art Unit 4184

/ISAM ALSOMIRI/
Primary Examiner, Art Unit 3662

12/29/2008